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INFLUENCE OF THE SEED SIZE AND VARIETY ON THE SEEDLING VIGOUR AND GERMINABILITY IN THREE VARIETIES OF SOFT WHEAT SEED

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Abstract

The objective of this research is to determine the effect of the seed size and variety on the germinability of the wheat (*Triticum aestivum* L.). Three fractions of seed size (>3 mm, 2-3 mm and <2 mm) and three varieties of soft wheat (*radika*, *amazon 150* and *pobeda*) were included as experimental factors. The seed was produced for commercial purposes from the category first generation certified seed (C1) in 2018. The laboratory examinations are conducted in the "Unilab" laboratory at the Faculty of Agriculture in Shtip. The laboratory is accredited pursuant to the MKC EN ISO/IEC 17025:2006 standard for several methods among which the method for examining the quality of the seed of agricultural crops. The amazon 150 variety had the lowest seedling vigour (87,75%), but the highest total germinability (94,33%). Contrary to amazon 150, the *pobeda* variety had the biggest seedling vigour (92,08%), but the lowest level of total germinability (93,25%). The differences of the seedling vigour and the germinability between the varieties did not show any statistical justifiability. The middle fraction (2-3 mm) had significantly higher seedling vigour than the other two fractions. The first and the middle fraction (>3 mm and 2-3 mm) had a significantly higher total germinability compared to the third fraction (<2 mm). The seed sized proved to have the biggest and most important effect on the total germinability (49,32%). The variety did not prove to be a significant factor that influences the total germinability.

Key words: *total germination, seedling vigour, variety, fraction, seed*

INTRODUCTION

The success of the production is under the influence of the genotypes, localities and cultivating technology, as well as of the environmental conditions (Đekić et al., 2014). Today's varieties of wheat are genetically highly selected and advanced biotechnical materials present in the mercantile production in terms of all the bases and all the requests (Sabovljević et al., 2010). It is generally known that the seed is the main factor for the transfer of the genetic characteristics of the variety and the improvement of the quality and the yield. A high quality and measured seed is a basic prerequisite for a successful production. The seed quality depends on the variety, i.e. it is genetically determined and, to a great extent, it is also defined by the cultivation conditions and the physiological processes. The research on different types of plants show that even though the seed quality is mainly hereditary, the agricultural and environmental conditions, the agriculture technology that has been applied, the quality of the seed material approbation, the further processing of the seed, storage, keeping, etc. may have great influence on the seed quality.

The genetic variability is the cause for the variability of the seed size among the varieties. However, the differences of the seed between one variety and another regarding the size and the weight are a result of the conditions of the external environment and the agriculture technology that has been applied. The variability of the seed size is under a huge influence of the

conditions of the external environment because in unfavourable cultivation conditions the participation of the lower fractions of the seed is significantly increased (Jevtić et al., 1985).

Seed size is an important physical indicator of seed quality that affects vegetative growth and is frequently related to yield, market grade factors and harvest efficiency (Rukavina et al., 2002). Most investigators have reported a positive relationship between seedling vigour, improved stand establishment and higher productivity of cereal crops with plants originating from large seed compared to those grown from smaller seed (Mohsen et al., 2011). Smaller seeds generally germinate faster providing greater competitive advantage especially in early successional stages (Baskin & Baskin, 1998). Nevertheless, larger seeds, although germinating slowly, often have higher percentage of germination than small seeds (Harper, 1977).

The seed with high seedling vigour and high germinability determines the potential for fast and equal germination and growth. These are the basic prerequisites that provide crops with good structure and strong growth and enable having a high yield.

The germinability of the seed is one of the most significant indicators for the seed quality, i.e. the living ability on which its used value depends on (Poštić et al., 2010). The germinability is ability of the seed, in favourable conditions, to provide a normal growth and development of sprouts from which the future plants will be developed.

However, apart from the high overall germinability, it is very important for the seed to have a high seedling vigour that, also, is a significant indicator for the living ability of the seed. In the production of every crop the fast and equal germination has a huge importance that depends directly on the seedling vigour of the seed (Poštić et al., 2010). The faster germination of the seed in minor conditions will provide better and more equal germination of the seeds, stronger development, better resistance to the conditions of the external environment, illnesses and pests since more developed plants have better resistance.

The seedling vigour represents the number of normal sprouts compared to the number of the seeds planted to germinate determined by the time foreseen for the first assessment, i.e. for the determination of the seedling vigour. The germinability of the seed represents the number of normal sprouts compared to the total number of seeds planted to germinate determined by the time foreseen for the final assessment has passed (Official Gazette of the Republic of Macedonia, No.61.2007).

Numerous researches show that the size or the weight of the seed and the contents of the nutritious elements in it have a great influence on the seedling vigour, the germinability and the growth potential in the germination stage. The results of the researches vary to a great extent from one type to another, even among varieties from the same type. According to this, the knowledge about which fraction of seed within a party of the seed has a better and which one has worse seedling energy and total germinability is of important practical value. By further procession of the seed the seedling energy and the total germinability of the seed can be improved.

The basic objective of this research is to determine the influence of the seed size on the seedling vigour and on the total germinability in laboratory conditions in three varieties of soft wheat. The varieties subject to research play an important role in the wheat production in our country. Hence, the knowledge about the influence of the variety on the seedling vigour and on the total germinability would have practical bearing.

MATERIAL AND METHODS

The research encompasses three varieties of wheat: radika, amazon 150 and pobeda. All three varieties are widely present in the wheat production in the Republic of Macedonia. The examinations have been conducted on average samples of parties of further processed seed from the category of first regeneration certified seed (C1) for each of the above stated varieties. The laboratory analyses have been conducted in the "Unilab" laboratory within the Plant and Environment Protection Department of the Faculty of Agriculture in Shtip. The laboratory is accredited in accordance with the MKC EN ISO/IEC 17025:2006 standards for several methods

among which the methods for examining the seed quality of agricultural crops.

The division of the seed into different fractions according to the size is performed with laboratory sieves with rectangular openings the size of which is 3mm and 2 mm. Three fractions have been set apart from the seed of each variety, seed larger than mm (>3 mm), seed with a size between 2 and 3 mm (2-3 mm) and a seed smaller than 2 mm (<2 mm).

A hundred seeds have been set apart four times from each variety and fraction to determine the seedling energy and the total germinability of the seed, i.e. a total number of nine variations with four repetitions have been created. In order to eliminate the influence of any potential seed infections it has been treated with 1% solution of Na hypochlorite.

Standard methods prescribed by the ISTA Rulebook (2010) and by the Rulebook on the mode of work, the equipment of the room and the technology of the authorized laboratories and methods for examining the seed material quality of agricultural crops (Official Gazette of the Republic of Macedonia No.61.2007) have been applied in order for the seedling vigour and the total germinability to be determined.

On the basis of the examined samples, the average values for each variety and fraction have been calculated. The mean values are statistically processed by using the basic parameters of the descriptive statistics. For analysis of variance (ANOVA) the statistical package SPSS (2010) was used. Least significant difference (LSD) was calculated using Statistical analysis system software JMP (2002).

RESULTS AND DISCUSSION

Seedling vigour

The seedling vigour, after the sowing determines the living ability of the seed, i.e. the uniform growth of healthy and strong sprouts. The seed size of the wheat is positively related to the living ability of the seed, which means that a larger seed has a tendency to produce more vital sprouts (Ries & Everson, 1973).

In Table 1 the average values of the seedling vigour of the examined varieties and fractions of wheat seed are presented.

Table 1. Seedling vigour (%)

Variety	Parameter	Seed fraction			Average variety
		>3	2-3	<2	
Radika	x	88,75	91	89	89.58
	min	85	88	87	
	max	92	93	91	
	I.V.	7	5	4	
	CV (%)	0,04	0,03	0,02	
Amazon 150	x	83	94,75	85,5	87.75
	min	75	93	83	
	max	94	97	89	
	I.V.	19	4	6	
	CV (%)	0,12	0,02	0,04	
Pobeda	x	92,25	92,75	91,25	92.08
	min	87	89	89	
	max	95	95	95	
	I.V.	8	6	6	
	CV (%)	0,04	0,03	0,03	
Average fraction		88	92.83	88.58	
$LSD_{0.05}$		Variety=4.03 Fraction=3.88			

x – arithmetic mean; min - minimum; max–maximum; I.V. – interval of variation; CV – coefficient of variation.

The lowest seedling vigour (83%) is shown to have the variety amazon 150 for the fraction >3 mm, while the highest seedling vigour (94,75%) of the same variety is found in the fraction 2-3 mm. Regardless of the fraction, the variety pobeda has shown to have the highest seedling vigour (92,08%), while the variety amazon 150 has the lowest seedling vigour (87,75%). The difference of the seedling vigour between these two varieties is statistically important.

Regardless of the variety, the highest seedling vigour (92,83%) is found in the middle fraction (2-3 mm) the value of which is significantly different compared to the one of the two other fractions. The other two fractions have almost the same seedling energy (88% of the fraction >3 and 88,85% of the fraction 2-3 mm).

The variation coefficient is more or less equal in all the varieties and fractions and varies from 0,02 to 0,04%, with the exception of the variety amazon 150 for the fraction >3 mm, where it is 0,12%. The same variety has the highest variation interval (19). All the other varieties have relatively equal seedling vigour.

The results that have been obtained show that the smaller seed has a greater seedling vigour, i.e. it germinates faster than the larger seed.

Total germination

In order to provide larger wheat production and to achieve stable yield, first and foremost it is necessary for high quality seed to be used in the sowing process, which is the primary task of the distribution and sale of seeds. The declared seed has high variety purity and a high percentage of germination (Savić et al., 2000).

The average values of the total germination of the examined varieties and fractions of wheat seed are given in Table 2.

Table 2. Total germination (%)

Variety	Parameter	1. Seed fraction			Average variety
		>3	2-3	<2	
Radika	x	96,5	92,5	92,5	93.83
	min	94	90	91	
	max	98	95	95	
	I.V.	4	5	4	
	CV (%)	2	2,25	2,07	
Amazon 150	x	95,5	97,75	89,75	94.33
	min	94	96	87	
	max	98	100	92	
	I.V.	4	4	5	
	CV (%)	2,01	1,75	2,3	
Pobeda	x	94,5	93	92,5	93.25
	min	91	90	90	
	max	97	95	97	
	I.V.	6	5	7	
	CV (%)	2,65	2,32	3,36	
Average fraction		95.42	94.42	91.58	
$LSD_{0.05}$		Variety=5.55 Fraction=2.16			

x – arithmetic mean; min - minimum; max - maximum; I.V. - interval of variation; CV - coefficient of variation.

The lowest total germination (89,75%) is determined with the variety amazon 150 for the fraction <2 mm, while the highest (97,75%) of the same variety is found to be with the fraction 2-3 mm. Regardless of the fraction, the highest total germination (94,33%) is obtained with the variety amazon 150, while the lowest (93,25%) has been obtained with the pobeda variety. The differences in the total germination between all three varieties that have been examined do not have the statistical justifiability.

Regardless of the variety, the fraction >3 mm (2-3 mm) has the highest total germination (95,42), while the fraction <2 mm has the lowest one (91,58%). The values that have been obtained are statistically different. The middle fraction (2-3 mm) has a total germination of 94,42% and it is not significantly different from the fraction >3 mm, while compared to the fraction <2 mm it is significantly higher.

In this case as well, the coefficients and the variation intervals of the varieties and fractions of wheat seed subject to examination were minor and relatively equal (Tab. 2).

The results show that the larger seed has a higher total germination. These results are in accordance with the research conducted by Stevanović et al., 2018, Farahani et al. 2011, and many more authors.

With the objective to see the influence of the variety and of the fraction on the seed and their interaction on the germinability of the seed of the varieties of wheat subject to examination, a two-way analysis of the variance has been conducted (Tab. 3). From the Table 3 it can be seen that the seed size has the biggest influence, i.e. the fraction of the seed (49,92%), while the share of the interaction between the variety and fraction of the seed is 47,01%. In this research it was shown that the variety, as a factor, is the least influential when the germinability of the seed is concerned (3.67%).

Table 3. Effect of variety and seed size on total germination

Factor	*SS*	*df*	MS	F	η
Total	192.389	8	24.049	5.103	
A	7.056	2	3.528	0.749	3.67
B	94.889	2	47.444	10.067	**49.32***
A x B	90.444	4	22.611	4.798	47.01
Error	12.250	27	4.713		

A - factor variety; B - factor seed fraction; A X B - interaction between variety and seed fraction; SS - sum of square; df - degrees of freedom; MS - mean square; F - F test; η - effect of factor; * - level of significant $p < 0.05$.

Farahani et al. (2011), found that the effect of seed size significantly affected the germination of wheat. In the researches of Zareian et al. (2013), the seed size did not have a significant influence on the germinability percentage.

CONCLUDING REMARKS

On the basis of the results that have been obtained from the examinations, it can be concluded that the seed size has a direct influence on the seedling vigour and on the total germination of the seed. The variety, as a factor, has not shown to have a significant influence on the seedling vigour and on the total germinability. The smaller seed had higher values of seedling vigour, while the larger seed had larger values of total germination. According to this, the smaller seed germinates faster compared to the larger seed, while the larger seed produces higher number of sprouts. All the varieties and fractions of the seed that were subject to examination showed high values of seedling vigour and total germination, which means that the seed with a size within the examined fractions can give good results in the production. With the aim for the seed quality to be further improved, the equipment for further processing of the seed should be adjusted so that the smaller seeds can be divided.

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ВЛИЈАНИЕТО НА ГОЛЕМИНАТА НА СЕМЕТО И СОРТАТА ВРЗ ЕНЕРГИЈАТА НА 'РТЕЊЕ И 'РТНОСТА КАЈ ТРИ СОРТИ МЕКА ПЧЕНИЦА

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Резиме

Целта на ова истражување беше да се утврди ефектот на големината на семето и сортата врз 'ртноста кај пченицата (*Triticum aestivum* L.). Како експериментални фактори беа вклучени три фракции според големината на семето (>3 mm, 2-3 mm и <2 mm) и три сорти мека пченица (радика, амазон 150 и победа). Семето беше произведено за комерцијални цели, од категоријата сертифицирано семе од прва генерација (C1), во 2018 година. Лабораториските испитувања се спроведени во лабораторијата „Унилаб", на Земјоделскиот факултет во Штип. Лабораторијата е акредитирана согласно стандардот МКС EN ISO/IEC 17025:2006 за повеќе методи, меѓу кои и методите за испитување на квалитет на семе од земјоделски растенија. Сортата амазон 150 имаше најмала енергија на 'ртење (87,75%), но најголема вкупна 'ртност (94,33%). Спротивно од амазон 150, сортата победа имаше најголема енергија на 'ртење (92,08%), но најмала вкупна 'ртност (93,25%). Разликите за енергијата на 'ртење и 'ртноста помеѓу сортите не покажаа статистичка оправданост. Средната фракција (2-3 mm) имаше значајно поголема енергија на 'ртење од останатите две фракции. Првата и средната фракција (>3 mm и 2-3 mm) имаа значајно поголема вкупна 'ртност во однос на третата (<2 mm). Најголем значаен ефект врз вкупната 'ртност имаше големината на семето (49,32%). Сортата како фактор не покажа значајно влијание врз вкупната 'ртност.

Клучни зборови: *вкупна 'ртност, енергија на 'ртење, сорта, фракција, семе*